Tractolira germonae, A New Abyssal Antarctic Volute

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ABSTRACT

Tractolira germonae, a new species of volute, is described from abyssal depths along the Scotia Arc, and assigned to the previously monotypic genus *Tractolira* on the basis of shell and radular morphology. Anatomical characters of this new species support the inclusion of *Tractolira* in the subfamily Odontocymbiolinae, and suggest a close relationship between the subfamilies Odontocymbiolinae and Zidoninae.

INTRODUCTION

The United States Antarctic Research Program (USARP) has been conducting research, including the sampling of Antarctic and Subantarctic biotas for nearly three decades. A study of the abyssal gastropods collected by USARP has uncovered a number of specimens of a new species of volute, apparently endemic to the perimeter of the Scotia Sea. This species described herein is assigned to the previously monotypic genus *Tractolira* Dall, 1896. The inclusion of *Tractolira* in the subfamily Odontocymbiolinae by Weaver and duPont (1970:133) rested on the statement by Dall (1907:365) that the now lost radula of *T. sparta* Dall, 1896, the type species from the abyssal zone off western Central America, "is marked by the same tusk-like cusps as are found in *Miomelon*", one of the two genera originally included in the subfamily. A description of the anatomy serves as the basis for a discussion of the phylogenetic affinities of *Tractolira* and Odontocymbiolinae.

SYSTEMATICS

Family **Volutidae** Rafinesque, 1815
Subfamily **Odontocymbiolinae** Clench and Turner, 1964
Genus *Tractolira* Dall, 1896

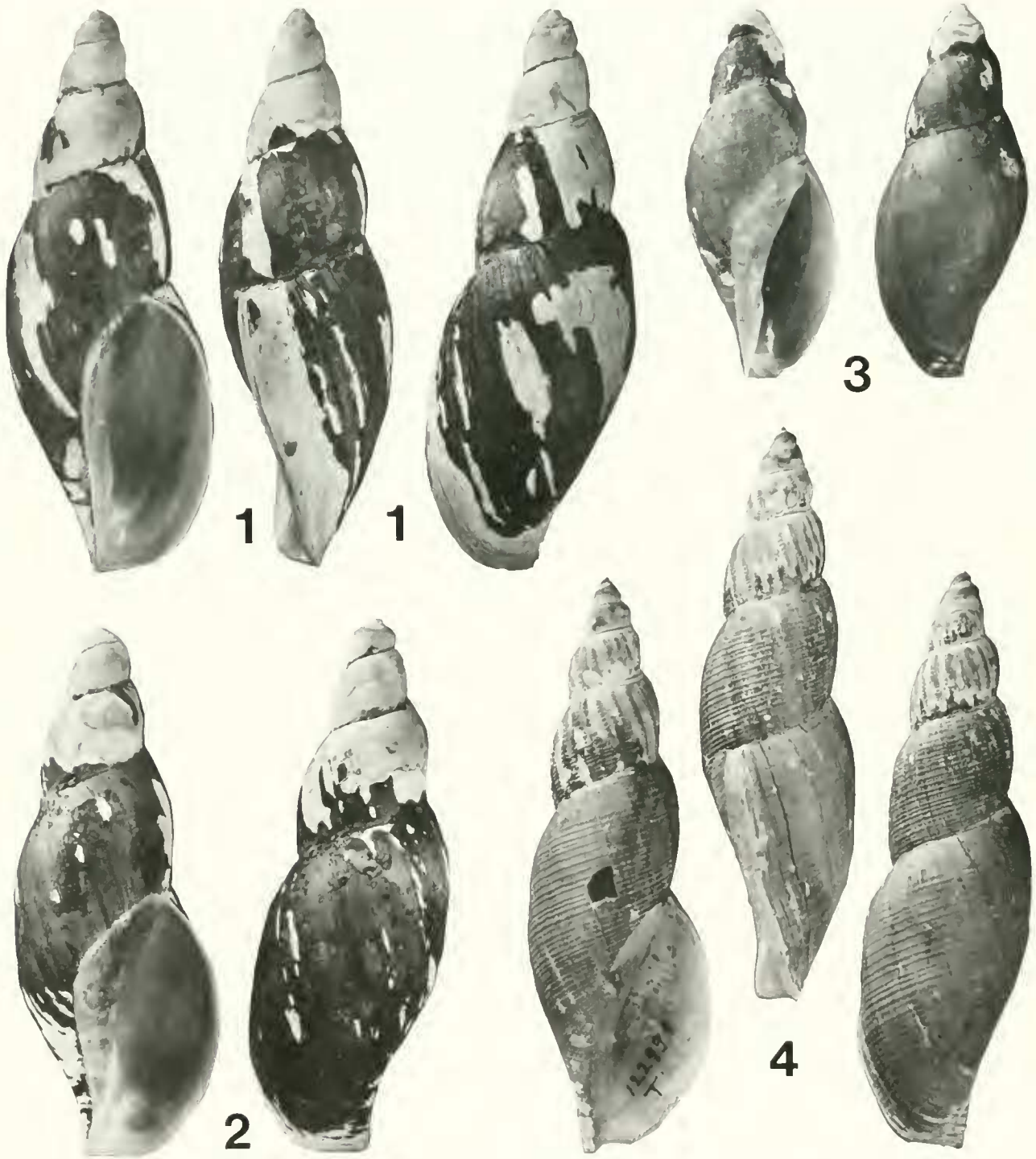
Tractolira germonae new species
(figures 1–3, 5–13; table 1)

Description: Shell (figures 1–3) to 60 mm, extremely thin, translucent, elongate, fusiform, eroded where not covered by periostracum (figures 5, 7). Protoconch badly eroded on all specimens, with vestiges of projecting calcarella at apex. Shell with up to five moderately convex whorls. Suture impressed. Spiral sculpture of 60–80 fine threads on body whorl, 20–30 on preceding whorls, decreasing in prominence with increase in shell size. Axial sculpture limited to fine growth striae. Aperture ovate. Outer lip smooth, slightly flared in larger specimens. Inner lip smooth, with thin transparent inductura along parietal region. Columella smooth, with raised white siphonal fold. Outer shell layer white to light tan, eroded areas of shell white, aperture white. Periostracum (figure 5) thin, greenish brown. Inner shell surfaces smooth, continuous.

Ultrastructure: Shell of three orthogonal layers of crossed lamellar crystals: outer layer 20 μm thick, with crystal faces perpendicular to growing edge; middle layer 120 μm thick, with crystal planes colabrally aligned; inner layer 12 μm thick, with crystal planes again perpendicular to growing edge. X-ray diffraction analysis showed shell to be composed almost exclusively (> 99%) of aragonite, with no significant amounts of calcite or vaterite.

External anatomy: Soft parts comprise three whorls, mantle cavity spans ½ whorl, kidney ⅓ whorl, digestive gland two whorls. Foot (L/W = 1.5) broad anteriorly, tapering posteriorly, with deep propodial mucous gland (figure 9, pmg). Operculum absent. Animal yellowish tan, without visible color pattern in alcohol-preserved material. Sole of foot deeply glandular, producing copious mucus. Siphon (figure 9, s) muscular, free, about ⅕ shell length. Two ventral appendages, equal in length, extend from base of siphon (figure 9, sa), one on each side of left cephalic tentacle (figure 9, t). Head broad, with short tentacles on each side of hood that extends over rhynchostome. Outer edges of tentacles with broad semicircular projections. Eyes absent.

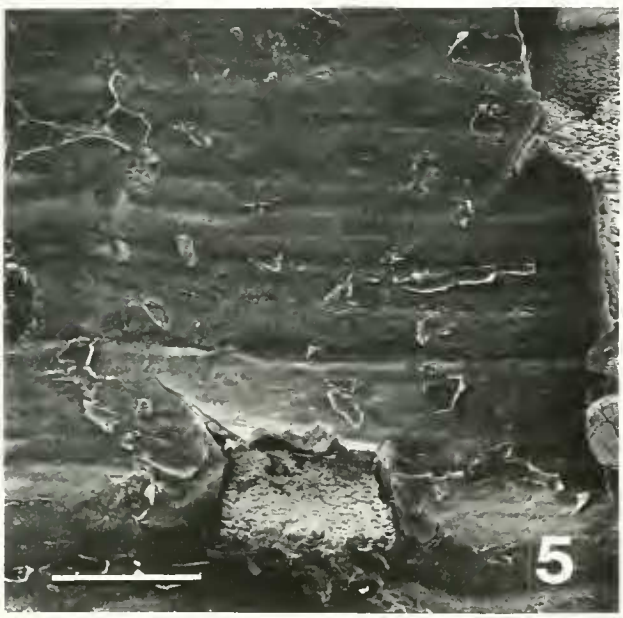
Mantle cavity: Arrangement of mantle cavity organs similar to that of *Alcithoe arabica* as described by Ponder (1970). Mantle edge thickened, muscular, smooth. Osphradium with 46 filaments below and 60 above osphradeal ganglion. Ctenidium, of about 200 filaments, slightly narrower (0.9 ×) and about 1.4 times as long as osphradium. Hypobranchial gland deeply glandular, producing purple secretion. Pericardium forms left rear

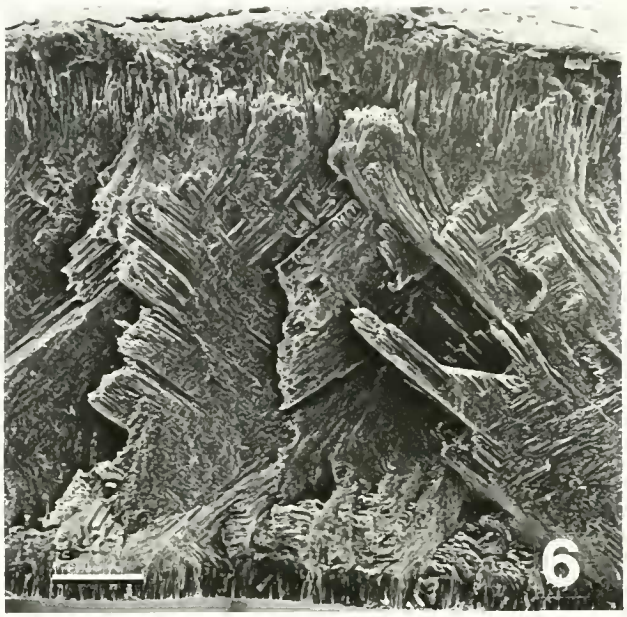


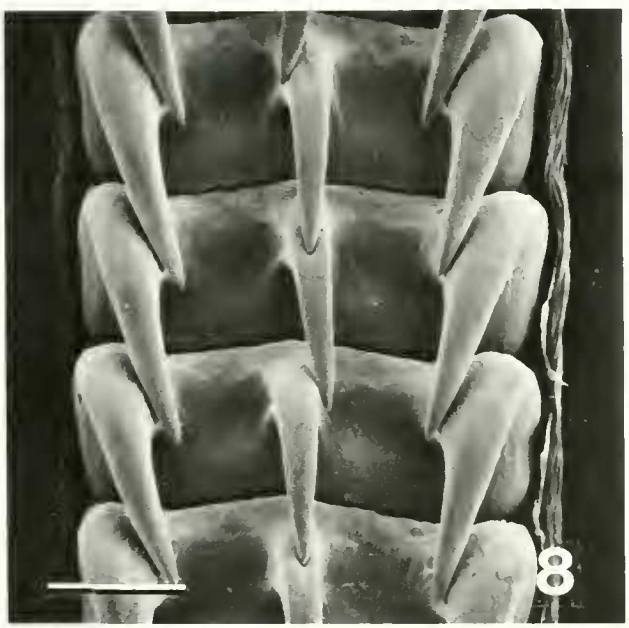
Figures 1–3. *Tractolira germonae* new species. **1.** Holotype, USNM 859076. **2.** Paratype 1, USNM 845611, both from Islas Orcada sta. 38, east of Candlemas Island, South Sandwich Islands, in 2,740–2,757 m. **3.** Paratype 5, USNM 845612, Islas Orcada sta. 51, south of Candlemas Island, South Sandwich Islands, in 2,248–2,402 m. **Figure 4.** *Tractolira sparta* Dall, 1896. Holotype, USNM 122999, Albatross sta. 3360, Gulf of Panama, in 3,058 m, sand bottom. All figures 1.5 ×.

wall of mantle cavity, ventricle diameter 2.5 × auricle diameter.

Alimentary system: Proboscis short, broad, pleurembolic, partially protruded in majority of specimens examined (figure 9, pb). Proboscis retractor muscles attached to walls of cephalic hemocoel. Mouth (figures 9, 10, m) triangular. Buccal mass (figure 10, bm) muscular. Radular ribbon short (5–7 mm), uniserial with 48–56 teeth, each with three tusk-like cusps. Central cusps



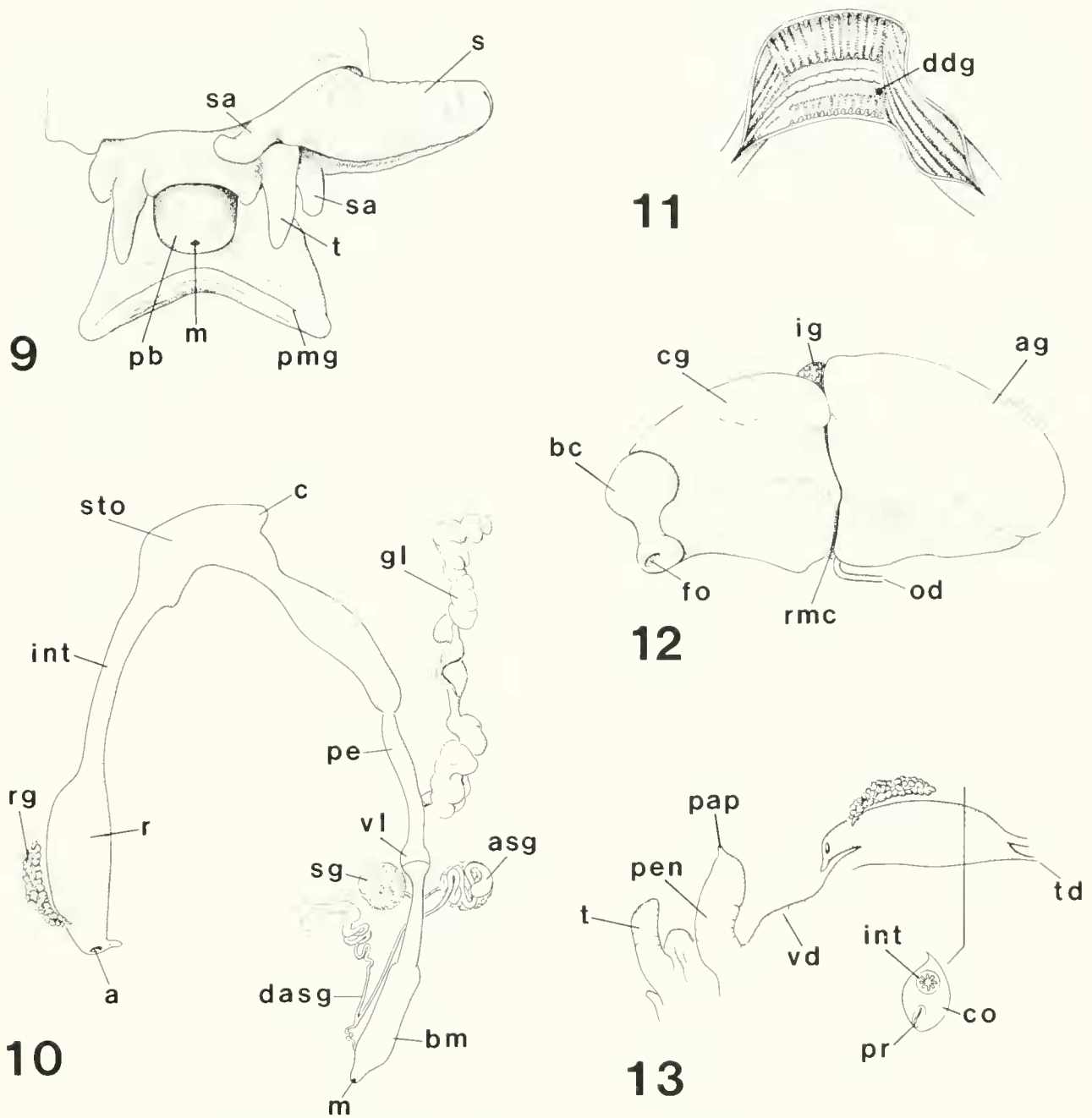




Figures 5–8. *Tractolira germonae* new species. **5.** Periostracum, scale bar = 200 μm. Note erosion of shell where not covered by periostracum. **6.** Shell ultrastructure, fracture surface parallel to growing edge, scale bar = 25 μm. **7.** Eroded surface of shell, scale bar = 80 μm. **8.** Radular ribbon, scale bar = 80 μm.

shorter and narrower than outer cusps (figure 8). Accessory salivary glands (figure 10, asg) wrapped tightly around salivary glands (figure 10, sg). Ducts of accessory salivary glands join (figure 10, dasg) before entering buccal cavity ventrally. Ducts of salivary glands run along the esophagus, entering buccal cavity dorso-laterally. Valve of Leiblein (figure 10, vl) large, nearly spherical. Gland of Leiblein (figure 10, gl), long, tubular, highly convoluted, fills posterior ⅔ of cephalic hemocoel. Posterior esophagus (figure 10, pe) reflected dorsally before joining U-shaped stomach. Section of stomach anterior to single duct from digestive gland (figure 11, ddg) tubular, with longitudinal folds. Posterior to digestive gland duct, stomach forms caecum (figure 10, c), becoming transversely pleated before joining intestine (figure 10, int). Intestine with longitudinal folds, expands into pink rectum (figure 10, r), with jade green anal gland (figure 10, ag) along distal ⅓ of its length. Anus (figure 10, a) with muscular rim and ventral papilla.

Female reproductive system: Ovary ascinous, whitish, on columellar side of digestive gland. Oviduct (figure



Figures 9–13. Anatomical features of *Tractolira germonae* new species. All figures 3.0 ×. **9.** Anterior view of animal. **10.** Alimentary system. **11.** Stomach, opened dorsally. **12.** Female glandular oviduct. **13.** Male pallial gonoduct.

a, anus; ag, albumen gland; asg, accessory salivary gland; bc, bursa copulatrix; bm, buccal mass; c, caecum; cg, capsule gland; co, connective tissue; dasg, duct accessory salivary gland; ddg, duct digestive gland; fo, female opening; gl, gland of Leiblein; ig, ingesting gland; int, intestine; m, mouth; od, oviduct; pap, papilla; pb, proboscis; pe, posterior esophagus; pen, penis; pmg, propodial mucous gland, pr, prostate gland; r, rectum; rg, rectal gland; rmc, rear mantle cavity; s, siphon; sa, siphonal appendage; sg, salivary gland; sto, stomach; t, tentacle; td, testicular duct; vd, vas deferens; vl, valve of Leiblein.

12, od), thin, leading to rear of mantle cavity and entering anterior ventral edge of albumen gland (figure 12, ag), which forms right wall of kidney. Pallial oviduct is joined by the purplish ingesting gland (figure 12, ig) before expanding into capsule gland (figure 12, cg). Bursa copulatrix (figure 12, bc) forms blind muscular diverticulum between female opening (figure 12, fo) and capsule gland.

Male reproductive system: Testis yellowish tan, lines right side of digestive gland. Testicular duct tubular, passing along pericardium before entering mantle cav-

ity. Prostate gland (figure 13, pr) slit ventrally, spans posterior half of mantle cavity. Prostate and rectum surrounded by connective tissue (figure 13, co) to form cylindrical mass. Vas deferens (figure 13, vd) descends to mantle floor, forming groove with fused edges that runs to base of penis (figure 13, pen). Penis short, dorsoventrally flattened, reflected posteriorly, with terminal papilla (figure 13, pap). Penial duct as in *Alcithoe arabica* (Ponder, 1970: fig. 32).

Kidney: Kidney similar to that of *Alcithoe arabica* (Ponder, 1970: fig. 33), consisting of nephridial gland adjacent to pericardium, heavily pleated dorsal area, and ventral area with seven large lamellae. Latter two areas each fed by branch of the renal vein. Kidney opening over renal vein on left side of kidney. Reno-pericardial opening at anterior upper left corner of kidney.

Nervous system: Nervous system Type 2 (Ponder, 1970: 159), with supraesophageal and right pleural ganglia fused.

Etymology: This species honors Mrs. Raye N. Germon, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, for her contributions to the study of Antarctic mollusks.

Type locality: East of Candlemas Island, South Sandwich Islands, 57°00.4′S, 27°10.1′W, in 2,740–2,757 m, Islas Orcada Cruise 575, sta. 38, May 22, 1975.

Holotype: USNM 859076, ♀, length 59.1 mm.

Paratypes: Paratypes 1–4, USNM 845611, from the type locality; paratypes 5–10, USNM 845612, paratype 11, ANSP A 11540, paratype 12, BM(NH) 198141, 57°22.6′S, 26°34.0′W, in 2,248–2,402 m, May 26, 1975, IO-575, sta. 51; paratypes 13–16, USNM 845613, 57°39.0′S, 26°00.4′W, in 2,380–2,609 m, May 27, 1975, IO-575, sta. 54; paratypes 17–19, USNM 845614, 56°29.5′S, 26°46.9′W, in 2,248–2,387 m, May 30, 1975, IO-575, sta. 63; paratypes 20–29, USNM 845615, paratypes 30–31, DMNH 169441, 56°03.5′S, 26°58.3′W, in 2,128–2,161 m, June 3, 1975, IO-575, 53°25.2′S, 45°17.0°W, in 2,632–2,691 m, June 12, 1975, IO-575, sta. 104.

Distribution: All live-collected specimens were taken off the South Sandwich Islands, with one record, based on shell fragments, from the Scotia Ridge. The confirmed bathymetric range for *T. germonae* is 2,161–2,740 m, with a mean station depth (n = 6) of 2,449 m. This species appears to be endemic to the Scotia Arc.

Ecology: All specimens of this abyssal species were taken on mud bottoms. Upper whorls of even the smallest specimens are eroded. The periostracum protects the shell from dissolution (figure 5), as this species lives below the aragonite compensation depth (Morse & Berner, 1979). A radular ribbon belonging to a naticid of the genus *Amauropsis* (Powell, 1951: fig. J) was found in the stomach of a dissected specimen.

Table 1. *Tractolira germonae* new species. Measurements of shell and radular characters. Linear measurements in mm. n = 10.

Character	X	Range	SD
Shell length	50.0	35.9–59.2	6.9
Aperture length	27.0	21.4–30.1	3.2
Shell length / Aperture length	0.540	0.503–0.586	0.028
Total # whorls	4.75	4.25–5.00	0.25
Spire angle	31.8°	28.8°–37.6°	2.8°
Radular length	6.2	5.0–6.8	0.6
# Radular rows	52.4	48–56	2.7

Comparative remarks: *Tractolira germonae* differs from *T. sparta* Dall, its only living congener, in having a broader, less elongate shell with a proportionally larger aperture, in lacking axial ribs on the early whorls and in having broader, less pronounced spiral sculpture. Neither preserved material of *T. sparta* nor the radula described by Dall are available, and anatomical comparisons cannot be made, other than to note that the radula of *T. germonae* resembles that of *Miomelon philippiana* (Dall, 1896) (Pilsbry & Olsson, 1954: pl. 3, fig. 9), therein agreeing with Dall's (1907:365) description of the radula of *T. sparta*. The holotype of *Tractolira sparta* was illustrated by Dall (1908). The specimen figured by Weaver and duPont (1970: pl. 56 G, H) as the holotype is a paratype (USNM 123000) from Malpelo Island, Colombia. The holotype of *T. sparta* is figured herein (figure 4).

DISCUSSION

Clench and Turner (1964:170) erected the taxon Odontocymbiolinae, a replacement name for the subfamily Adelomeloninae Pilsbry and Olsson (1954), to include the South American genera *Odontocymbiola* and *Miomelon*. Although some species in these genera strongly resemble some members of the Zidoninae in shell form, Odontocymbiolinae can be readily identified by their characteristic radular teeth, which have "fang-like" denticles. Other characters that serve to differentiate the Odontocymbiolinae include the presence of the long, symmetrical siphonal appendages, tubular accessory salivary glands that are tightly wound around compact salivary glands, a vas deferens that forms a closed duct, a penis with closed duct and terminal papilla, and a stomach with a tubular anterior region. Although figured (pl. 82, figure 36), the last feature was not discussed by Clench and Turner (1964). Weaver and duPont (1970) provisionally included the abyssal eastern Pacific genus *Tractolira* and the Australian genus *Volutoconus* in Odontocymbiolinae, largely on the basis of radular morphology.

The inclusion of *Tractolira* in Odontocymbiolinae is further supported by features of the salivary glands, accessory salivary glands, stomach, and male reproductive

system. Although fang-like cusps are present in *Tractolira*, they are not as elaborately modified as in some other members of the subfamily (Weaver & duPont, 1970: figure 27). The protoconch of *Tractolira*, with its pointed calcarella, more closely corresponds to that of *Adelomelon ancilla* (Solander, 1786) (Clench & Turner, 1964: pl. 93), a member of the Zidoninae, than to those of Odontocymbiolinae (Clench & Turner, 1964: pl. 82, fig. 35). The penis of *Tractolira* has the duct and papilla of Odontocymbiolinae, but resembles that of Zidoninae in size and disposition.

In view of the numerous similarities in anatomy and shell morphology between the Zidoninae and Odontocymbiolinae (Clench & Turner, 1964), and because the character states that have been used to distinguish the Odontocymbiolinae are clearly derived from homologous features in the Zidoninae, it is suggested that these two subfamilies are sister groups, with the Odontocymbiolinae being derived from the Zidoninae, and that *Tractolira* is a primitive genus within the Odontocymbiolinae. Zoogeographic distributions of Recent species (Weaver & duPont, 1970) further suggest that the Zidoninae radiated in the Austral Province (Kauffman, 1973) during the Cretaceous, while the geographically more restricted Odontocymbiolinae evolved in the Weddellian Province (Zinsmeister, 1979, 1982) after the separation of New Zealand at the end of the Early Paleocene.

Dall (1907:365) proposed "*Voluta*" *alta* Sowerby, 1844, from shallow water early Tertiary deposits of Chile, as an ancestor of *Tractolira*. It is here proposed that the genus *Tractolira* colonized the abyssal regions of the Peru Basin during the early Tertiary, and that speciation of *T. germonae* is due to vicariance resulting from the displacement of tectonic fragments from the Pacific hinterland of the Andean-West Antarctic Cordillera into the southwestern Atlantic during the Cenozoic (Dalziel & Elliot, 1973).

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